[0154] What is claimed:

1. A base station configured to communicate with a plurality of communication devices over a wideband communication channel comprising an overall bandwidth segmented into a plurality of sub-channels, the base station configured to:

divide a single serial message intended for one of the plurality of communication devices into a plurality of parallel messages;

encode each of the plurality of parallel messages onto at least some of the plurality of sub-channels; and

transmit the encoded plurality of parallel messages to the communication device over the wideband communication channel.

2. The base station of claim 1, further configured to encode each of the plurality of parallel bit streams onto multiple sub-channels of the plurality of sub-channels in such a manner as to provide frequency diversity.

3. The base station of claim 1, further configured to:

assign one or more of the plurality of sub-channels to each of the plurality of communication devices;

divide each of a plurality of serial messages, which are each intended for one of the plurality of communication devices, into a plurality of parallel messages;

encode each of the plurality of parallel messages onto the sub-channels assigned to the corresponding communication device; and

transmit the encoded plurality of parallel messages to each of the plurality of communication devices over the wideband communication channel.

4. The base station of claim 3, further configured to encode each of the plurality of parallel bit streams onto multiple sub-channels of the plurality of sub-channels in such a manner as to provide frequency diversity.

5. The base station of claim 3, wherein the number of communication devices assigned sub-channels is programmable by the base station.

6. The base station of claim 3, further configured to assign the sub-channels to particular communication devices based at least in part on signal-to-interference measurements received from each of the plurality of communication devices.

7. The base station of claim 3, configured to:

organize the plurality of sub-channels into sub-channel group;

receive a mean signal-to-interference measurement from each of the plurality of communication devices for each sub-channel group;

compare each mean signal interference measurement to a threshold value; and

assign sub-channel groups to particular communication devices of the plurality of communication devices based on the comparisons of the mean signal interference ratio measurements to the threshold value.

8. The base station of claim 1, further configured to:

assign one or more of the plurality of sub-channels to each of the plurality of communication devices;

generate a bit stream for each assigned sub-channel;

shift each bit stream in frequency by a frequency offset associated with the corresponding sub-channel;

sum the shifted bit streams to generate a single transmit signal that occupies the entire overall bandwidth; and

transmit the single transmit signal to each of the plurality of communication devices assigned a sub-channel.

9. The base station of claim 8, wherein each bit stream comprises symbols of a certain symbol duration.

10. The base station of claim 9, wherein each sub-channel comprises a bandwidth that is defined by the following equation:

$$b = (1 + r)/T;$$

where b = the bandwidth for each of the plurality of sub-channels

r = a roll-off factor; and

T = the symbol duration for each of the plurality of sub-channels,

and wherein the overall bandwidth is defined by the following equation:

$$B = N\,(1 + r)/T;$$

where B = the overall bandwidth; and

N = the number of sub-channels.

11. The base station of claim 10, wherein the roll-off factor is selected so that M in the following equation is approximately an integer:

$$M = N\,(1 + r).$$

12. The base station of claim 1, comprising a plurality of antennas, wherein the encoded plurality of parallel messages are transmitted over the wideband communication channel using each of the plurality of antennas so as to provide spatial diversity.

13. A communication system, comprising:

a plurality of communication devices; and

a base station configured to communicate with the plurality of communication devices over a wideband communication channel comprising an overall bandwidth segmented into a plurality of sub-channels, the base station configured to:

divide a single serial message intended for one of the plurality of communication devices into a plurality of parallel messages;

encode each of the plurality of parallel messages onto at least some of the plurality of sub-channels; and

transmit the encoded plurality of parallel messages to the communication device over the wideband communication channel.

14. The communication system of claim 13, further configured to encode each of the plurality of parallel bit streams onto multiple sub-channels of the plurality of sub-channels in such a manner as to provide frequency diversity.

15. The communication system 14, further configured to:

assign one or more of the plurality of sub-channels to each of the plurality of communication devices;

divide each of a plurality of serial messages, which are each intended for one of the plurality of communication devices, into a plurality of parallel messages;

encode each of the plurality of parallel messages onto the sub-channels assigned to the corresponding communication device; and

transmit the encoded plurality of parallel messages to each of the plurality of communication devices over the wideband communication channel.

16. The communication system of claim 15, further configured to encode each of the plurality of parallel bit streams onto multiple sub-channels of the plurality of sub-channels in such a manner as to provide frequency diversity.

17. The communication system of claim 15, wherein the number of communication devices assigned sub-channels is programmable by the base station.

18. The communication system of claim 15, further configured to assign the sub-channels to particular communication devices based at least in part on signal-to-interference measurements received from each of the plurality of communication devices.

19. The communication system of claim 15, configured to:

organize the plurality of sub-channels into sub-channel group;

receive a mean signal-to-interference measurement from each of the plurality of communication devices for each sub-channel group;

compare each mean signal interference measurement to a threshold value; and

assign sub-channel groups to particular communication devices of the plurality of communication devices based on the comparisons of the mean signal interference ratio measurements to the threshold value.

20. The communication system of claim 15, wherein each of the plurality of communication devices is configured to receive each of the plurality of sub-channels and to only decode the messages encoded onto sub-channels assigned to the communication device.

21. The communication system of claim 20, wherein each of the plurality of communication devices is further configured to combine the decoded messages into a single serial message.

22. The communication system of claim 13, further configured to:

assign one or more of the plurality of sub-channels to each of the plurality of communication devices;

generate a bit stream for each assigned sub-channel;

shift each bit stream in frequency by a frequency offset associated with the corresponding sub-channel;

sum the shifted bit streams to generate a single transmit signal that occupies the entire overall bandwidth; and

transmit the single transmit signal to each of the plurality of communication devices assigned a sub-channel.

23. The communication system of claim 13, wherein the base station comprises a plurality of antennas, and wherein the base station is further configured to transmit the encoded plurality of parallel messages over the wideband communication channel using each of the plurality of antennas so as to provide spatial diversity.

24. The communication system of claim 13, wherein each of the plurality of communication devices comprises a plurality of antennas, and each of the plurality of communication devices is configured to receive the transmitted plurality of parallel messages using each of the plurality of antennas so as to provide spatial diversity.

25. A method of communicating over a wideband communication channel divided into a plurality of sub-channels, comprising:

dividing a single serial message intended for one of the plurality of communication devices into a plurality of parallel messages;

encoding each of the plurality of parallel messages onto at least some of the plurality of sub-channels; and

transmitting the encoded plurality of parallel messages to the communication device over the wideband communication channel.

26. The method of claim 25, wherein encoding each of the plurality of parallel bit streams onto multiple sub-channels comprises encoding the plurality of parallel bit streams in such a manner as to provide frequency diversity.

27. The method of claim 24, further comprising:

assigning one or more of the plurality of sub-channels to each of the plurality of communication devices;

dividing each of a plurality of serial messages, which are each intended for one of the plurality of communication devices, into a plurality of parallel messages;

encoding each of the plurality of parallel messages onto the sub-channels assigned to the corresponding communication device; and

transmitting the encoded plurality of parallel messages to each of the plurality of communication devices over the wideband communication channel.

28. The method of claim 27, wherein encoding each of the plurality of parallel bit streams onto multiple sub-channels comprises encoding the plurality of parallel bit streams in such a manner as to provide frequency diversity..

29. The method of claim 27, further comprising changing the number of communication devices assigned sub-channels based on a predetermined criteria..

30. The method of claim 29, further comprising changing the number of communication devices assigned sub-channels based at least in part on signal-to-interference measurements received from each of the plurality of communication devices.

31. The method of claim 27, further comprising:

organizing the plurality of sub-channels into sub-channel group;

receiving a mean signal-to-interference measurement from each of the plurality of communication devices for each sub-channel group;

comparing each mean signal interference measurement to a threshold value; and

assigning sub-channel groups to particular communication devices of the plurality of communication devices based on the comparisons of the mean signal interference ratio measurements to the threshold value.

32. The base station of claim 25, further comprising:

assigning one or more of the plurality of sub-channels to each of the plurality of communication devices;

generating a bit stream for each assigned sub-channel;

shifting each bit stream in frequency by a frequency offset associated with the corresponding sub-channel;

summing the shifted bit streams to generate a single transmit signal that occupies the entire overall bandwidth; and

transmitting the single transmit signal to each of the plurality of communication devices assigned a sub-channel.

33. A transmitter, comprising:

a serial-to-parallel transformer configured to transform a single serial bit stream comprising messages for a plurality of communication device into a plurality of bit streams;

a modulator configured to perform time division modulation or frequency division modulation on each of the plurality of bit streams; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

34. The transmitter of claim 33, further comprising:

a scrambler configured to scramble each of the plurality of bit streams;

an encoder configured to encode each of the plurality of bit streams; and

an interleaver configured to interleave each of the plurality of bit streams.

35. The transmitter of claim 34, further comprising a symbol mapper configured to perform symbol mapping on each of the plurality of bit streams.

36. The transmitter of claim 35, wherein the type of symbol mapping used on each of the plurality of bit streams is programmable based on signal to interference measurements provided by each of the plurality of communication devices.

37. The transmitter of claim 33, wherein the modulator is further configured to filter each of the plurality of bit streams to provide a required pulse shaping for each of the plurality of bit streams.

38. The transmitter of claim 33, further comprising a RF transmitter configured to transmit the single transmit signal over a communication channel comprising sub-channels corresponding to each of the plurality of bit streams.

39. The transmitter of claim 33, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

40. A transmitter, comprising

a serial-to-parallel transmitter configured to transform a single serial bit stream comprising messages for a plurality of communication device into a plurality of bit streams;

a time division modulator configured to perform time division modulation on each of the plurality of bit streams;

a filter configured to apply a required pulse shaping to each of the plurality of bit streams;

a frequency shifter configured to shift each of the plurality of bit streams in frequency by a required amount; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

41. The transmitter of claim 40, wherein the time division modulator comprises, for each bit stream;

a sub-block repeater configured to take a sub-block of data from the bit stream and form a new sub-block comprising the original sub-block repeated two or more times;

a block terminator configured to add a termination prefix to the new sub-block ; and

a sync inserter configured to periodically insert a synchronization code into the bit streams .

42. The transmitter of claim 41, wherein the time division modulator further comprises for each bit stream a sub-block scrambler configured to scramble the new sub-block generated by the sub-block repeater.

43. The transmitter of claim 42, wherein the time division modulator further comprises for each bit stream a block repeater configured to generate another new sub-block comprising the terminated new sub-block repeated two or more times.

44. The transmitter of claim 43, wherein the block repeater is further configured to scramble the new sub-block that it generates.

45. The transmitter of claim 41, wherein the block terminator is configured to perform block termination using a cyclic prefix or a known sequence prefix.

46. The transmitter of claim 40, wherein the sub-block repeater, sub-block scrambler, and the block repeater, are configured to be turned on and off as required.

47. The transmitter of claim 40, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

48. A transmitter, comprising:

a serial-to-parallel transformer configured to transform a single serial bit stream comprising messages for a plurality of communication device into a plurality of bit streams;

a frequency division modulator configured to perform frequency division modulation an each of the plurality of bit streams,

a filter configured to apply a required pulse shaping to each of the plurality of bit streams;

a frequency shifter configured to shift each of the plurality of bit streams in frequency by a required amount; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

49. The transmitter of claim 48, wherein the frequency division modulator comprises, for each bit stream:

a sub-block repeater configured to take a sub-block of data from the bit stream and form a new sub-block comprising the original sub-block repeated twice;

a block terminator configured to add a cyclic termination prefix to the new sub-block; and

a sync inserter configured to periodically insert a synchronization code into the bit stream.

50. The transmitter of claim 49, wherein the frequency division modulator further comprises for each bit stream a sub-block scrambler configured to scramble the new sub-block generated by the sub-block repeater.

51. The transmitter of claim 50, further comprising for each bit stream a block coder configured to code the scrambled new sub-block.

52. The transmitter of claim 51, further comprising for each bit stream an inverse transformer configured to generate a transformed sub-block comprising the inverse fast fourier transform of the coded new sub-block, and wherein the block terminator is configured to add a cyclic termination prefix to the transformed sub-block .

53. The transmitter of claim 52, wherein the sub-block repeater, sub-block scrambler, block coder, and inverse transmitter are configured to be turned on and off as required.

54. The transmitter of claim 48, wherein the transmitter is configured such that it can be used in an indoor communication system,

and outdoor communication system, or a line of sight communication system.

55. A transmitter, comprising:

a serial-to-parallel transformer configured to transform a single serial bit stream with an overall data rate into a plurality of bit streams;

a modulator configured to perform time division modulation or frequency division modulation on each of the plurality of bit streams;

a rate controller configured to adjust the overall data rate; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

56. The transmitter of claim 55, wherein the rate controller is configured to adjust the overall data rate by spreading the plurality of bit streams in the frequency domain.

57. The transmitter of claim 55, wherein the rate controller is configured to adjust the overall data rate down by encoding n data streams onto m channels, where $m > n$.

58. The transmitter of claim 57, wherein the rate controller is further configured to scramble the duplicate bit streams.

59. The transmitter of claim 55, wherein the rate controller is configured to adjust the overall data rate by:

splitting each of the plurality of bit streams into a first bit stream and a second bit stream, and

delaying each second bit stream by half a symbol period relative to each first bit stream;

and wherein the modulator is further configured to :

filter each first and second bit stream, and

sum each filtered first bit stream and each filtered second bit stream together.

60. The transmitter of claim 55, wherein the rate controller is configured so that it can be programmed to increase the overall data rate or decrease the overall data rate.

61. The transmitter of claim 48, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

62. A transmitter, comprising:

a serial-to-parallel transformer configured to transform a single serial bit stream into a plurality of bit streams;

a modulator configured to perform time division modulation or frequency division modulation on each of the plurality of bit streams;

a frequency encoder configured to encode information from more than one of the plurality of bit streams onto each of a plurality of frequencies corresponding to a plurality of sub-channels; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

63. The transmitter of claim 62, wherein the frequency encoder is configured so that the type of frequency encoding performed is programmable.

64. The transmitter of claim 62, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

65. A transmitter, comprising:

a serial-to-parallel transformer configured to transform a single serial bit stream with an overall data rate into a plurality of bit streams;

a modulator configured to perform time division modulation or frequency division modulation on each of the plurality of bit streams;

a rate controller configured to adjust the overall data rate, and

a frequency encoder configured to encode information from more than one of the plurality of bit streams onto each of a plurality of frequencies corresponding to a plurality of sub-channels; and

a summer configured to sum the plurality of bit streams into a single transmit signal.

66. The transmitter of claim 65, wherein the rate controller and frequency encoder are configured to be turned on and of as required.

67. The transmitter of claim 65, wherein the rate controller is configured so that it can be programmed to increase the overall data rate or decrease the overall data rate.

68. The transmitter of claim 65, wherein the frequency encoder is configured so that the type of frequency encoding performed is programmable.

69. The transmitter of claim 65, wherein the modulator is configured so that the type of modulation can be programmed.

70. The transmitter of claim 65, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

71. A receiver, comprising:

a RF receiver configured to receive a transmit signal comprising a plurality of bit streams, each bit stream comprising a frequency offset;

a frequency shifter configured to shift the frequency of each of the plurality of bit streams so as to remove the corresponding frequency offset;

a filter configured to filter each of plurality of bit streams so as to apply a correct pulse shaping to each of the plurality of bit streams;

an equalizer configured to perform equalization on each of the plurality of bit streams; and

a parallel-to-serial transformer configured transform the plurality of bit streams into a single serial bit stream.

72. The receiver of claim 71, wherein the received transmit signal comprises an overall bandwidth divided into a plurality of sub-

channels, and wherein the frequency offsets of each of the plurality of bit streams correspond to a particular sub-channel.

73. The receiver of claim 72, wherein the frequency shifter is programmed to only shift the frequency for those of the plurality of bit streams that correspond to sub-channels that have been assigned to a communication device comprising the receiver.

74. The receiver of claim 71, further comprising:

a descrambler for descrambling each of the plurality of bit streams;

a decoder for decoding each of the plurality of bit streams; and

a deinterleaver for deinterleaving each of the plurality of bit streams.

75. The receiver of claim 71, wherein the equalizer is a time domain equalizer or a frequency domain equalizer.

76. The receiver of claim 75 wherein the equalizer is a single-in-single-out equalizer, a multiple-in-single-out equalizer, or a multiple-in-multiple-out equalizer.

77. The receiver of claim 71, further comprising a synchronizer configured to synchronize the receiver with a synchronization code included in the received transmit signal.

78. The receiver of claim 71, wherein the received transmit signal comprises an overall bandwidth that is divided into a plurality of sub-channels, and wherein the receiver further comprises an estimator configured to estimate a signal to noise and interference ratio for each sub-channel.

79. The receiver of claim 71, wherein the received transmit signal comprises an overall bandwidth that is divided into a plurality of sub-channels, and wherein the receiver further comprises an estimator configured to estimate the channel impulse response for each sub-channel.

80. The receiver of claim 71, wherein the transmitter is configured such that it can be used in an indoor communication system, and outdoor communication system, or a line of sight communication system.

81. A method for generating a plurality of synchronization codes for use in a communication system, comprising:

selecting a perfect sequence ;

generating a first synchronization code of the plurality of synchronization codes by repeating the perfect sequence a number of times equal to a reuse factor of the communication system;

generating each subsequent synchronization code of the plurality of synchronization codes by shifting the first synchronization code in

frequency by one or more sample bins depending on which synchronization code of the plurality of synchronization codes is being generated; and

adding a number of samples equal to a multipath length for the communication system to the front of each synchronization code of the plurality of synchronization codes.

82. The method of 81, wherein shifting the first synchronization code in frequency by one or more sample bins is achieved using the following equation:

$$z^r(m) = y(m)*exp(j*2*\pi*r*m/(n*L)),$$

where: $r = 1$ to L, L being the length of the perfect sequence being used generate the synchronization codes,

$z^r(m)$ = each subsequent sequence,

$y(m)$ = the first sequence,

n = the number of times the perfect sequence is repeated,

and

$m = 0$ to $n*L-1$.

83. A communication system, comprising a plurality of base stations configured to communicate with a plurality of communication devices over a common communication channel, each base station

configured to use a unique synchronization code relative to other adjacent base stations when communicating with the plurality of communication devices over the communication channel, the communication channel comprising an overall bandwidth that is divided into a plurality of sub-channels.

84. The system of claim 83, wherein the synchronization codes have ideal cross correlation properties relative to each other.

85. The system of claim 83, configured to use a particular synchronization code reuse factor.

86. The system of claim 85, wherein the reuse factor is 4.

87. The system of claim 83, wherein the synchronization codes are generated by:

selecting a perfect sequence ;

generating a first synchronization code by repeating the perfect sequence a number of times equal to a reuse factor of the communication system;

generating each subsequent synchronization code by shifting the first synchronization code in frequency by one or more sample bins depending on which synchronization code is being generated; and

adding a number of samples equal to a multipath length for the communication system to the front of each synchronization.